The Role of E-learning in Medical Education during the COVID-19 Pandemic: A Cross-Sectional Study of Student Perception

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Abstract

Background: In march 2020, with the declaration of COVID-19 as a global pandemic, the schools, colleges, and universities of the highly contagious areas of the world were instantaneously closed to mitigate the deleterious effects of COVID-19. Moreover, as a result of social distancing, the most effective preventative strategy since the emergence of COVID-19, medical education has been profoundly disturbed. In light of the prevailing pandemic, an abrupt shifting of the educational system was made from face-to-face learning to online methodologies to provide uninterrupted education to the students of the affected countries. By and large, traditional education was replaced by various forms of e-learning. The aim of this study was to evaluate the perception of e-learning in undergraduate medical students at Medical Colleges during covid pandemic. **Material & Methods:** This was a cross-sectional questionnaire-based study and was conducted from December, 2020 to February, 2021 in the CARe Medical College, Dhaka, Bangladesh. In the present study we included 270 undergraduate medical students as our participants and students who were not willing to participate were excluded from our study. **Results:** In our study we found the mean age of the respondents was 23.05 ± 1.28 years and majority of our students were female (68%) compared to male (32%). Most of the students (67%) had moderate grade of IT skills. We found major advantage of e-learning was the ability to record classes 67% and the disadvantage was poor internet speed (68.9%). Among all students, 51.1% & 6.7% students were able to increase knowledge, 62.6% & 3% were able to increase clinical skill and 37.8% & 7.4% were able to increase social skill via conventional & e-learning methods respectively. Majority (88.1%) students preferred face-to face learning method and 11.9% preferred e-learning method. **Conclusion:** In our study, we evaluated the student's perception of e-learning and its associated advantages and disadvantages in terms of learning outcomes. While comparing e-learning and face-to-face learning among undergraduate medical students,we found face-to-face learning was considered the most effective way of learning to increase knowledge, practical skills and social skills. Therefore, most of our students preferred the face-to-face learning method compared to e-learning.

INTRODUCTION

Human coronavirus 2019, also called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is responsible for the respiratory disease COVID-19.[1] The COVID-19 pandemic is an unprecedented event in modern history that has not been witnessed in the last 100 years.[2] The World Health Organization (WHO) declared COVID-19 as a Public Health Emergency of International Concern on 30 January 2020 and a global pandemic on 11 March 2020 and.[3,4] To control the spread of the virus, basic measures like physical distancing, wearing masks, washing hands frequently, keeping rooms well-ventilated, and avoiding crowds were recommended.[5] This pandemic has affected all industries worldwide, including education.[6] Schools, colleges, and universities in the very contagious areas were closed immediately to limit the deleterious effects of COVID-19.[7] Medical education has been particularly affected by the pandemic as it involves in-person didactic lectures and tutorials, clinical rotation exposure, laboratory experiences, and observing and assisting relevant medical and surgical procedures, which are not possible during social distancing.[8,9,10] To provide uninterrupted education to the students of the affected countries, the educational system was shifted abruptly from face-to-face learning to online methodologies.[11] This pandemic accelerated the process of partial replacement of traditional education by e-learning, which was already in progress.[12,13] Encouraging e-learning in the modern world of education has become necessary in this crisis. E-learning platforms can be used to deliver lectures remotely at one's convenience, and discussions can be facilitated live using video and audio conferencing. Active participation of students has a positive effect on e-learning. High-income countries have good experiences in e-learning for education of health professionals.[14,15] However, in low and middle-income countries, only a few countries have limited experience in e-learning in health professional education and mainly in postgraduate training.[16,17]

Medical education is considered unique compared to other educational domains offered at higher institutions of learning.[18] Students are not only expected to study books but also have to acquire clinical skills, particularly during clinical years. E-learning was initially thought to compromise the clinical skills of medical students, but it was necessary to restrict face-to-face learning to prevent the transmission of SARS-CoV-2 among students and patients. A study has also supported the positive impact of e-learning in increasing not only the clinical and basic subject knowledge but also imparting a beneficial impact in terms of increasing the clinical skills to deal with patients as well.[19] Similar studies conducted worldwide have validated the significance and effectiveness of e-learning, and its wide-based adoption has also been appreciated by many learners throughout the globe.[20,21]

E-learning, also known as online education, is defined as the learning utilization of electronic technologies to access educational curriculum outside of traditional face-to-face learning in the classroom.[22] However, experiences with e-learning at medical colleges were limited during the introduction of lockdown.[23] College authorities and lecturers had to make a great effort to adapt to the changing education system. Lecturers were not for the teaching

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process of e-learning platforms or applications such as MS Teams, ZOOM, and others, and had to spend a lot of time becoming familiar with e-learning methods, which was especially difficult for clinicians burdened with patient care.[24] Consequently, classes were prolonged, or not all material was realized, and some students could not attend the classes due to technical problems. Moreover, most of the students returned to their own homes, which resulted in disruption of learning by household members or the lack of a place to study.[23] The most challenging issue in e-learning was to provide a good standard of practical experiences for medical students.[25]

In this study we aimed to evaluate the perception of e-learning in undergraduate medical students during covid pandemic.

MATERIAL AND METHODS

This was a cross-sectional questionnaire-based study and was conducted from December, 2020 to February, 2021 in the CARe Medical College, Dhaka, Bangladesh. In the present study we included 270 undergraduate medical students as our participants and students who were not willing to participate were excluded from our study.

The questionnaire included 12 questions: sociodemographic data (gender, age, year of study), grade of IT skill, available devices, technologies, advantage and disadvantage of e-learning. The participants answered some of the questions with a Likert scale (1 = Definitely ineffective,2=Ineffective, 3= Neutral, 4= Effective 5 = Definitely effective). The effectiveness of learning objectives like knowledge, clinical skills and social competence was assessed by comparing two modes of education (Traditional and E-learning) based on a Likert scale (1 = Definitely ineffective, 5 = Definitely effective).

Statistical Analysis: All data were recorded systematically in preformed data collection form and quantitative data was expressed as mean and standard deviation and qualitative data was expressed as frequency distribution and percentage. Statistical analysis was performed by using SPSS 21 (Statistical Package for Social Sciences) for windows version 10. Probability value <0.05 was considered as level of significance. The study was approved by Ethical Review Committee of CARe Medical College, Dhaka, Bangladesh.
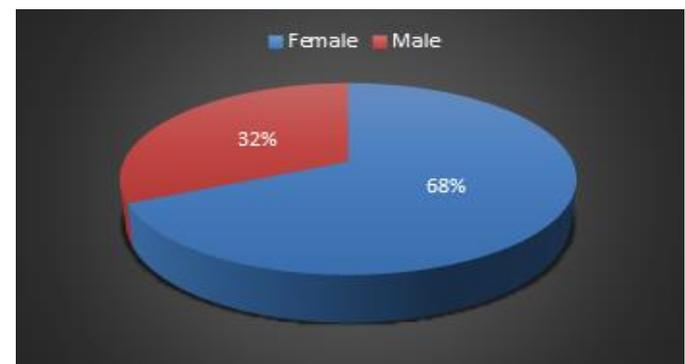
RESULTS

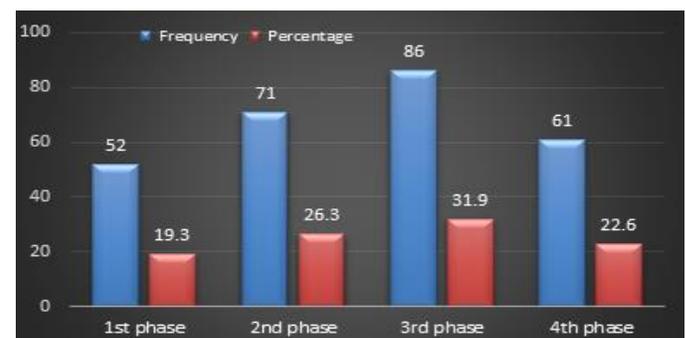**Figure 1:** Gender distribution of our study subjects

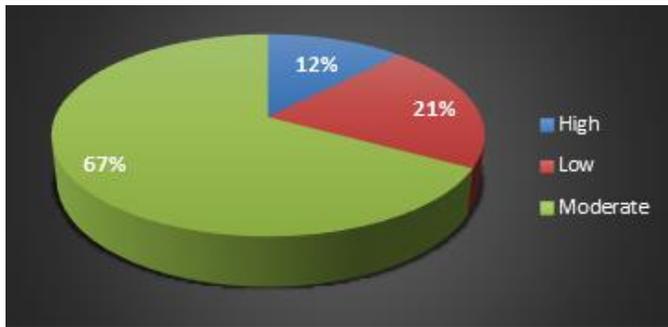**Figure 2:** Distribution of the study subjects according to phase of study

Figure 3: Distribution of the study subjects according to competence in IT (N=270).
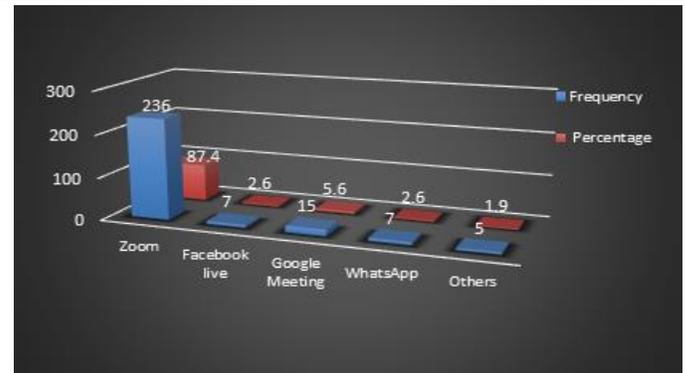

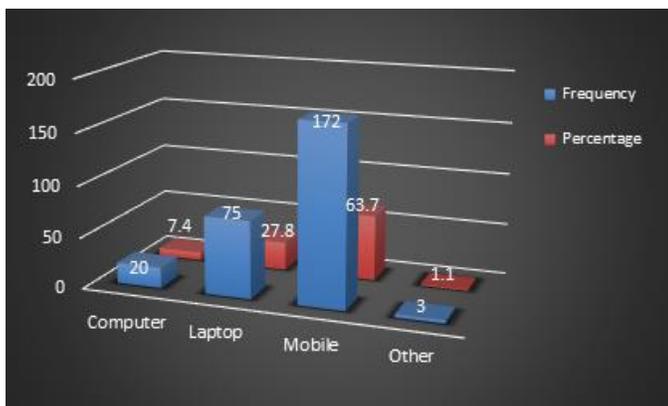**Figure 5:** Online platform used during e-learning (N=270)

Figure 4: Devices used during e-learning (N=270)
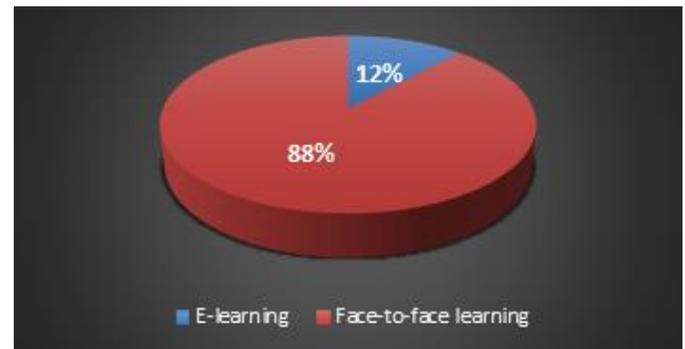
Figure 6: Methods preferred for learning

Table 1: Distribution of the study subjects according to age (N=270)

Age (Years)	Frequency (n)	Percentage (%)
19-22 years	97	35.93
23-26 years	169	62.59
>26 years	4	1.48
Mean ± SD (years)	23.05 ± 1.28	
Min – max	19 - 28	

Table 2: Advantages of e-learning (N=270)

Advantages	Frequency (n)	Percentage (%)
Flexibility in planning and self-paced learning	108	40.0
Better time management	127	47.0
Ability to record classes	181	67.0
Easier access to class material	123	45.6
Sufficient possibilities to interact with classmates	23	8.5
Remote learning opportunities	95	35.2

Table 3: Disadvantages of e-learning (N=270)

Disadvantages	Frequency (n)	Percentage (%)
Unavailability of gadgets	26	9.6
Poor internet speed	186	68.9
Insufficient IT skill	50	18.5
Less of interaction with faculty and patients	162	60.0
Physical problems like headache	178	65.9

Table 4: Students perception regarding e-learning by students' category (N=270)

Variables	Students Category		Total	p-value
	Basic	Clinical		
Advantages of e-learning				
Flexibility in planning and self-paced learning	88 (42.1)	20 (32.8)	108 (40.0)	0.191
Better time management	112 (53.6)	15 (24.6)	127 (47.0)	<0.001
Ability to record classes	146 (69.9)	35 (57.4)	181 (67.0)	0.068
Easier access to class material	102 (48.8)	21 (34.4)	123 (45.6)	0.047
Sufficient possibilities to interact with classmates	21 (10.0)	2 (3.3)	23 (8.5)	0.063
Remote learning opportunities	70 (33.5)	25 (41.0)	95 (35.2)	0.281
Disadvantages of e-learning				
Unavailability of gadgets	24 (11.5)	2 (3.3)	26 (9.6)	0.056
Poor internet speed	141 (67.5)	45 (73.8)	186 (68.9)	0.349
Insufficient IT skill	44 (21.1)	6 (9.8)	50 (18.5)	0.047
Less of interaction with faculty and patients	122 (58.4)	40 (65.6)	162 (60.0)	0.313
Physical problems like headache	143 (68.4)	35 (57.4)	178 (65.9)	0.109

Table 5: Comparison of perception and effectiveness of traditional vs. e-learning method

Likert scale rating	1	2	3	4	5	Mean	p-value
Questionnaires	n (%)	n (%)	n (%)	n (%)	n (%)		
Ability to increase knowledge via face to face learning	13 (4.8)	11 (4.1)	23 (8.5)	85 (31.3)	138 (51.1)	4.20	<0.001
Ability to increase knowledge via e-learning	23 (8.5)	60 (22.2)	106 (39.3)	63 (23.3)	18 (6.7)	2.97	
Ability of increase practical/clinical skill via face to face learning	17 (6.3)	11 (4.1)	12 (4.4)	61 (22.6)	169 (62.6)	4.31	<0.001
Ability of increase practical/clinical skill via e-learning	95 (35.2)	92 (34.1)	57 (21.1)	18 (6.7)	8 (3.0)	2.08	

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Ability to increase social skill via face to face learning	14 (5.2)	18 (6.7)	44 (16.3)	92 (34.1)	102 (37.8)	3.92	<0.001
Ability of increase social skill via e-learning	52 (19.3)	64 (23.7)	93 (34.4)	41 (15.2)	20 (7.4)	2.67	

In [Table 1] we showed our age distribution of our study subjects. Majority (62.59%) of our students were 23- 26 years, followed by 35.93% were 19 – 22 years old and only 4 (1.48%) were > 26 years old. The mean age was 23.05 ± 1.28 years.

[Figure 1] showed the gender distribution of study subjects. Majority of our students were female (68%) compared to male (32%). [Figure 2] shows that majority (31.9%) of students were in 3rd phase, followed by 26%,23% & 19% were in 2nd, 4th & 1st phase of medical year respectively. [Figure 3] shows that most of the students (67%) had moderate grade of IT, followed by 21% & 12% had low & high grade of IT respectively. [Figure 4] shows that majority (63.7%) of students used mobile, 27.8% used laptop, 7.4% & 1.1% used computer & other devices respectively. Figure 5 shows that 87.4% students used zoom application, 5.6% used google meet, 2.6% used Facebook live & WhatsApp and 1.9% used other application.

Ability to record classes was the major E-learning advantage chosen by 67% (181) of students (P=0.068) followed by better time management 47%, easier access to class material 45.6%, flexibility in planning and self-paced learning 40%, remote learning opportunities 35.2%. While analyzing the disadvantage of E-learning poor internet speed 68.9% (186) was chosen as the major disadvantage by the students (P=.349), followed by physical problems like headache (65.9%), less interaction with faculty and patients (60%) & insufficient IT skill (18.5%), summarized in table- 2,3,4. [Table 5] shows the comparison between face-to-face vs e-learning. Ability to increase knowledge; the students mentioned that the conventional method of learning is very effective to increase the knowledge than e- learning (M-4.20, M-2.97) (P= <0.001). E-learning was considered less effective than face to face learning in term of increased practical/clinical skill (M-4.31,M-2.08) (P= <0.001) and social skill/ competence (M-3.92, M-2.67) (P= <0.001).

[Figure 6] shows that majority (88.1%) students preferred face-to face learning method and 11.9% preferred e-learning method.

DISCUSSION

Using E-learning as a teaching tool for medical education can provide an effective alternative to traditional on-site education and can help address the shortage of healthcare providers and educators.[14] According to Hugenholtz et al., e-learning can be very effective in medical education.[26] Additionally, e-learning has been found to be associated with cost savings compared to traditional methods of education. However, there are several hurdles that must be overcome to ensure the success of e-learning. These include access to communication technologies and secure, stable internet capacity, and insufficient experience in

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implementing e-learning. In addition, a lack of technical skills and computer proficiency may inhibit educators' ability or willingness to engage in the development or delivery of e-learning.[27] While e-learning was being used in a limited scale in medical education both in developing country context, the Covid 19 pandemic greatly widened its use very rapidly and thereby, created both the scope and necessity to study its advantages and limitations. How the learners perceived this method of teaching is an important yardstick in this regard and our study was focused on such an aspect.

In our study the mean age was 23.05 ± 1.28 years [Table 1]. Gismalla et al found the mean (± SD) age was 20.4 (2.07) years and ranged between 17 and 27 years.[27] A study done by Dyrek et al found mean age 23±19 years.[28] Another study by S. Maqbool et al found the mean age of students was 21.49 ± 1.79 years [29]. Majority of our students were female (68%) compared to male (32%) [Figure 1]. Other studies found female respondents had predominance over male respondents.[27,28,29] In this study majority (31.9%) of students were in 3rd phase of medical year [Figure 2]. In relation phase of students, our study is dissimilar to the study by Gismalla et al & Dyrek et al.[27,28] The findings of S. Maqbool were similar to our study.[29] In this study most of the students (67%) had moderate grade of IT skill [Figure 3]. A study by S. Maqbool et al found the majority of the students (68.2%) have moderate levels of IT skills which is similar to ours.[29] Our study is in contrast to the study conducted on medical students in Poland where most of the students (n = 451, 56%) were acquainted with high levels of IT skills.[30] In our study ability to record classes

(67%), better time management (47%), easier access to class material (45.6%), flexibility in planning and self-paced learning (40%) and remote learning opportunities (35.2%) came out as the major advantages of e-learning [Table 2]. Most of the advantages pointed out by the respondents are in line with the usual benefits of self-paced e-learning. This could be as self-directed e-learning allows learners to take control of their own learning pace and style, which can lead to greater engagement and retention of information as has been noted by Peine et al.[40]

As per our study the major disadvantages of e-learning were poor internet speed (68.9%), physical problems like headache (65.9%), less student-teacher interaction (60%) and insufficient IT skill (18.5%) [Table 3]. In our study the most common technical problem faced by the students was poor internet connections during online classes. This finding was in concordance with other studies conducted to assess the disadvantages of online learning which were also validating the problem of internet connectivity during online classes.[32] Many studies have also reported that excessive use of internet networks in almost every field of life during the COVID-19 pandemic was the main cause of slow internet connections.[33] In the same vein, a study conducted in Kerala was reporting the problem of internet connectivity and associated technical issues among 43.7% of the students who were taking online classes.[34] Similarly, another barrier hindering the successful delivery of online education was lack of skilled staff for delivering online lectures.[35] The other disadvantages were lack of interaction with patients and teachers as consistent with other

studies conducted to assess the medical student's perceptions of E-learning during the COVID-19 pandemic followed by lack of self-discipline, poor learning conditions at home, and social isolation.[36]

In our study majority of the students preferred face-to-face learning over e-learning when it comes to improving their knowledge, clinical skills, and social skills [Table 5] . These findings are consistent with other studies conducted to evaluate the levels of effectiveness between e-learning and face-to-face learning.[37,38] Similar preference for face-to-face learning among medical students were reported in Pakistan and Iran.[29] Lack of sufficient infrastructure, students' negative attitudes, poor internet access, instructors' lack of experience, and the inability to conduct clinical demonstrations through the e-learning platform are the most frequent factors that make e-learning less effective in medical education.[39] The level of prereference for online learning was 73% observed in Polish medical students in Poland, which is much lower in case of Iran and Pakistan. One potential explanation could be the lack of resources and affordability during lockdown conditions in Pakistan and Iran compared to Poland.[29,30] .Similar reasons may be behind findings of our study. In the present study we found that majority (88.1%) of our

students preferred face-to face learning method while only 11.9% preferred e-learning method [Figure 6].[40]

Limitations of the study

Our study was a single centre study. A possible limitation of our study is that we have taken a small sample size because of short study period and as a consequence the results cannot be easily generalized.

CONCLUSIONS

In our study, we evaluated the student's perception of e-learning and its associated advantages and disadvantages in terms of learning outcomes. While comparing e-learning and face-to-face learning among undergraduate medical students we found face-to-face learning was considered the most effective way of learning to increase knowledge, practical skills and social skills. Therefore, most of our students preferred the face-to-face learning method compared to e-learning.

We urge that additional studies on online learning should be conducted so that students' perspectives on positive and negative impacts may be studied and necessary steps can be taken to prevent poor learning outcomes.

REFERENCES

1. Lai CC, Shih TP, Ko WC, Tang HJ, Hsueh PR. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease-2019 (COVID-19): The epidemic and the challenges. Int J Antimicrob Agents. 2020;55(3):105924. doi: 10.1016/j.ijantimicag.2020.105924.

2. Bulut C, Kato Y. Epidemiology of COVID-19. Turk J Med Sci. 2020;50(SI-1):563-570. doi: 10.3906/sag-2004-172.

3. Petrosillo N, Viceconte G, Ergonul O, Ippolito G, Petersen E. COVID-19, SARS and MERS: are they closely related? Clin Microbiol Infect. 2020;26(6):729-734. doi: 10.1016/j.cmi.2020.03.026.

4. Zhang XY, Huang HJ, Zhuang DL, Nasser MI, Yang MH, Zhu P, et al. Biological, clinical and epidemiological features of COVID-19, SARS and

MERS and AutoDock simulation of ACE2. Infect Dis Poverty. 2020;9(1):99. doi: 10.1186/s40249-020-00691-6.

5. Rao Lahiri P, Panja S, Chattopadhyay M, Biswas J, Dhali A, Dhali GK. Perception of Online Learning Among Undergraduate Medical Students of Eastern India: A Cross-Sectional Study. Cureus. 2022;14(12):e32580. doi: 10.7759/cureus.32580.

6. Ayittey FK, Ayittey MK, Chiwero NB, Kamasah JS, Dzuvor C. Economic impacts of Wuhan 2019-nCoV on China and the world. J Med Virol. 2020; 92(5):473–5.

7. Rajab MH, Gazal AM, Alkattan K. Challenges to Online Medical Education During the COVID-19 Pandemic. Cureus. 2020;12(7):e8966. doi: 10.7759/cureus.8966.

8. Del Rio C, Malani PN. 2019 Novel Coronavirus-Important Information for Clinicians. JAMA. 2020;323(11):1039-1040. doi: 10.1001/jama.2020.1490.

9. Rose S. Medical Student Education in the Time of COVID-19. JAMA. 2020;323(21):2131-2132. doi: 10.1001/jama.2020.5227.

10. Tokuç B, Varol G. Medical Education in Turkey in Time of COVID-19. Balkan Med J. 2020;37(4):180-181. doi: 10.4274/balkanmedj.galenos.2020.2020.4.003.

11. Maqbool S, Farhan M, Abu Safian H, Zulqarnain I, Asif H, Noor Z, et al. Student's perception of E-learning during COVID-19 pandemic and its positive and negative learning outcomes among medical students: A country-wise study conducted in Pakistan and Iran. Ann Med Surg (Lond). 2022;82:104713. doi: 10.1016/j.amsu.2022.104713.

12. Arroyo-Morales M, Cantarero-Villanueva I, Fernández-Lao C, Guirao-Piñeyro M, Castro-Martín E, et al. A blended learning approach to palpation and ultrasound imaging skills through supplementation of traditional classroom teaching with an e-learning package. Man Ther. 2012;17(5):474-8. doi: 10.1016/j.math.2012.04.002.

13. Chumley-Jones HS, Dobbie A, Alford CL. Web-based learning: sound educational method or hype? A review of the evaluation literature. Acad Med. 2002;77(10 Suppl):S86-93. doi: 10.1097/00001888-200210001-00028.

14. Belfi LM, Dean KE, Bartolotta RJ, Shih G, Min RJ. Medical student education in the time of COVID-19: A virtual solution to the introductory radiology elective. Clin Imaging. 2021;75:67-74. doi: 10.1016/j.clinimag.2021.01.013.

15. Kim S. The future of E-Learning in medical education: current trend and future opportunity. J Educ Eval Health Prof. 2006;3:3. doi: 10.3352/jeehp.2006.3.3.

16. Frantz JM, Bezuidenhout J, Burch VC, Mthembu S, Rowe M, Tan C, et al. The impact of a faculty development programme for health professions educators in sub-Saharan Africa: an archival study. BMC Med Educ. 2015;15:28. doi: 10.1186/s12909-015-0320-7.

17. Frehywot S, Vovides Y, Talib Z, Mikhail N, Ross H, Wohltjen H, et al. E-learning in medical education in resource constrained low- and middle-income countries. Hum Resour Health. 2013;11:4. doi: 10.1186/1478-4491-11-4.

18. Olum R, Atulinda L, Kigozi E, Nassozi DR, Mulekwa A, Bongomin F, et al. Medical Education and E-Learning During COVID-19 Pandemic: Awareness, Attitudes, Preferences, and Barriers Among Undergraduate Medicine and Nursing Students at Makerere University, Uganda. J Med Educ Curric Dev. 2020;7:2382120520973212. doi: 10.1177/2382120520973212.

19. Gormley GJ, Collins K, Boohan M, Bickle IC, Stevenson M. Is there a place for e-learning in clinical skills? A survey of undergraduate medical students' experiences and attitudes. Med Teach. 2009;31(1):e6-12. doi: 10.1080/01421590802334317.

20. Abbasi S, Ayoob T, Malik A, Memon SI. Perceptions of students regarding E-learning during Covid-19 at a private medical college. Pak J Med Sci. 2020;36(COVID19-S4):S57-S61. doi: 10.12669/pjms.36.COVID19-S4.2766.

21. Sahu PK, Dalcik H, Dalcik C, Gupta MM, Chattu VK, Umakanthan S. Best practices for effective implementation of online teaching and learning in medical and health professions education: during COVID-19 and beyond. AIMS Public Health. 2022;9(2):278-292. doi: 10.3934/publichealth.2022019.

22. Masic I. E-learning as new method of medical education. Acta Inform Med. 2008;16(2):102-17. doi: 10.5455/aim.2008.16.102-117.

23. Alsiö Å, Wennström B, Landström B, Silén C. Implementing clinical education of medical students in hospital communities: experiences of healthcare professionals. Int J Med Educ. 2019;10:54-61. doi: 10.5116/ijme.5c83.cb08.

24. Dost S, Hossain A, Shehab M, Abdelwahed A, Al-Nusair L. Perceptions of medical students towards

online teaching during the COVID-19 pandemic: a national cross-sectional survey of 2721 UK medical students. BMJ Open. 2020;10(11):e042378. doi: 10.1136/bmjopen-2020-042378.

25. Gill D, Whitehead C, Wondimagegn D. Challenges to medical education at a time of physical distancing. Lancet. 2020;396(10244):77-79. doi: 10.1016/S0140-6736(20)31368-4.

26. Hugenholtz NI, de Croon EM, Smits PB, van Dijk FJ, Nieuwenhuijsen K. Effectiveness of e-learning in continuing medical education for occupational physicians. Occup Med (Lond). 2008;58(5):370-2. doi: 10.1093/occmed/kqn053.

27. Gismalla MA, Mohamed M, Ibrahim O. et al. Medical students' perception towards E-learning during COVID 19 pandemic in a high burden developing country. BMC Med Educ. 2021;21:377.

28. Dyrek N, Wikarek A, Niemiec M, Owczarek AJ, Olszanecka-Glinianowicz M, Kocełak P. The perception of e-learning during the SARS-CoV-2 pandemic by students of medical universities in Poland - a survey-based study. BMC Med Educ. 2022;22(1):529. doi: 10.1186/s12909-022-03600-7.

29. Maqbool S, Farhan M, Abu Safian H, Zulqarnain I, Asif H, Noor Z, et al. Student's perception of E-learning during COVID-19 pandemic and its positive and negative learning outcomes among medical students: A country-wise study conducted in Pakistan and Iran. Ann Med Surg (Lond). 2022;82:104713. doi: 10.1016/j.amsu.2022.104713.

30. Bączek M, Zagańczyk-Bączek M, Szpringer M, Jaroszyński A, Wożakowska-Kapłon B. Students' perception of online learning during the COVID-19 pandemic: A survey study of Polish medical students. Medicine (Baltimore). 2021;100(7):e24821. doi: 10.1097/MD.0000000000024821.

31. Amesse LS, Callendar E, Pfaff-Amesse T, Duke J, Herbert WN. Evaluation of Computer-aided Strategies for Teaching Medical Students Prenatal Ultrasound Diagnostic Skills. Med Educ Online. 2008;13:13. doi: 10.3885/meo.2008.Res00275.

32. Sindiani AM, Obeidat N, Alshdaifat E, Elsalem L, Alwani MM, Rawashdeh H, et al. Distance education during the COVID-19 outbreak: A cross-sectional study among medical students in North of Jordan.

Ann Med Surg (Lond). 2020;59:186-194. doi: 10.1016/j.amsu.2020.09.036.

33. Pei L, Wu H. Does online learning work better than offline learning in undergraduate medical education? A systematic review and meta-analysis. Med Educ Online. 2019;24(1):1666538. doi: 10.1080/10872981.2019.1666538.

34. Rafi AM, Varghese PR, Kuttichira P. The Pedagogical Shift During COVID 19 Pandemic: Online Medical Education, Barriers and Perceptions in Central Kerala. J Med Educ Curric Dev. 2020;7:2382120520951795. doi: 10.1177/2382120520951795.

35. Adekoya AO, Ehioghae O, Adesegun OA, Adekoya AO, Abolurin OO, Idowu AO, et al. Knowledge, Perceptions and Levels of Utilisation of E-Learning among Medical Students in Nigeria. West Afr J Med. 2023;40(2):161-168.

36. Al-Balas M, Al-Balas HI, Jaber HM, Obeidat K, Al-Balas H, Aborajooh EA, et al. Distance learning in clinical medical education amid COVID-19 pandemic in Jordan: current situation, challenges, and perspectives. BMC Med Educ. 2020;20(1):341. doi: 10.1186/s12909-020-02257-4.

37. Aoe M, Esaki S, Ikejiri M, Ito T, Nagai K, Hatsuda Y, et al. Impact of Different Attitudes toward Face-to-Face and Online Classes on Learning Outcomes in Japan. Pharmacy (Basel). 2023;11(1):16. doi: 10.3390/pharmacy11010016.

38. Yoo H, Kim D, Lee YM, Rhyu IJ. Adaptations in Anatomy Education during COVID-19. J Korean Med Sci. 2021;36(1):e13. doi: 10.3346/jkms.2021.36.e13.

39. Barrot JS, Llenares II, Del Rosario LS. Students' online learning challenges during the pandemic and how they cope with them: The case of the Philippines. Educ Inf Technol (Dordr). 2021;26(6):7321-7338. doi: 10.1007/s10639-021-10589-x.

40. Peine A, Kabino K, Spreckelsen C. Self-directed learning can outperform direct instruction in the course of a modern German medical curriculum - results of a mixed methods trial. BMC Med Educ. 2016;16:158. doi: 10.1186/s12909-016-0679-0.

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